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REVISION OF THE NORTH AMERICAN APHID GENUS *BIPERSONA* HOTTES (HEMIPTERA: APHIDIDAE)

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Abstract.—Adult female apterae and alates of the genus *Bipersona* Hottes are described and illustrated. *Bipersona torticauda* (Gillette), previously a junior synonym of *Bipersona ochrocentri* (Cockerell), is now considered a valid species.

Key Words: aphid, thistle, *Bipersona torticauda*, *Bipersona ochrocentri*

The aphid genus *Bipersona* Hottes (1926) was proposed for a group of thistle-inhabiting aphids with unusual morphology of the cauda and anal plate. The cauda of these species is elongate, narrow, and appears twisted or constricted along its length, and the anal plate has a posteriorly directed projection. *Bipersona* lives on various species of thistles in the genus *Cirsium* (Asteraceae) and the aphids invariably are attended by ants. The recent synonymy (Eastop and Blackman 2005) of *Bipersona hottesi* Knowlton and Smith (= *Eomacrosiphum nigromaculosum* MacDougall) resulted in a monotypic genus.

Samples sent to one of us (GLM) prompted further examination of the types of the recognized and synonymized species listed under *Bipersona* by Remaudière and Remaudière (1997) and Eastop and Blackman (2005). After that examination, it was certain that several specimens housed in the National Museum of Natural History Aphidoidea Collection collected from Arizona and New Mexico are not referable to *Bipersona torticauda* (Gillette). A thorough study of *Bipersona* was therefore undertaken for clarification.

MATERIALS AND METHODS

Synoptic descriptions are taken from original descriptions and specimens borrowed from various museums and private collections across North America including: the Essig Museum of Entomology (EMEC), University of California, Berkeley, CA; Colorado State University Collection (CSUC), Fort Collins, CO; the Florida State Collection of Arthropods (FSCA), Gainesville, FL; the Illinois Natural History Survey (INHS), Champaign, IL; National Museum of Natural History Aphidoidea Collection (USNM), Beltsville, MD; University of Minnesota Insect Collection (UMSP), St. Paul, MN; Utah State University Entomological Museum (EMUS), Logan, UT; Canadian National Collection of Insects (CNCI), Ottawa, Canada; and individual collections of F. W. Quednau

(FWQC), Sainte-Foy, Canada, and the collection of the second author (ASJC). Codens (except individual collections) are as in Bejsak-Collorado-Mansfield (2004). Morphological terms and structures adapted from Stoetzel et al. (1999) are used in this work. Measurements are presented in millimeters as minimum and maximum ranges of representative specimens. Drawings were begun using a camera lucida, and completed either by hand or by computer-aided illustration programs (Adobe Illustrator® or Adobe Photoshop®). Most specimens had been cleared and mounted in Canada balsam, while others were mounted in gum-based mountants.

The information under Specimens Examined is organized to conserve space. Abbreviations for apterae, alatae, oviparae, fundatrix, and immatures are listed as: ap., al., ov., fund., and imm. respectively. If a collection was made at the same locality, but on a different date as a previously listed collection, duplicated information is not repeated. Months are designated as roman numerals. For example, the documentation provided for a particular locality may be recorded as: NEBRASKA: War Bonnet Creek, V-26-2003, on *Cirsium nebraskense* [= *Cirsium canescens*], D. C. Beard coll. (2 al.) USNM; IV-10-1988, VII-29-1989, I-21-1991, on *Cirsium* sp. (15 ap. on 15 sl.) USNM. In this hypothetical example, the second collection was also found at War Bonnet Creek, even though "War Bonnet Creek" was not repeated. Collection data that are the same except for collection date are simply listed sequentially. In examples where microscope slides record county, they are listed first within each state then chronologically. Other collection localities are listed chronologically. When specimens are mounted on a single slide (sl.), it is not written as such but is assumed. Bracketed ([ ]) text represents supplemental information by the current authors for clarification purposes.

Results

During the time this paper was in review, Eastop and Blackman (2005) placed *Bipersona hottesi* Knowlton and Smith (1936) as a junior synonym of *Eomacrosiphon nigromaculosom* (MacDougall). Their decision was based on "no significant differences between this species [*E. nigromaculosom*] and the description of *Bipersona hottesi* found on wild *Rosa* in Utah, other than the twisted cauda of the latter" and they believed the condition of the cauda "was an artefact of the mounting process" (Eastop and Blackman 2005). We concur with Eastop and Blackman's (2005) synonymy. After we examined in detail the type slide of *B. hottesi* (USNM), another specific should be mentioned. While Knowlton and Smith's (1936) description of *B. hottesi* is based on two apterous viviparous specimens on a single slide, the slide in fact contains three species as follows: three alate viviparae of *Macrosiphum euphorbiae* (Thomas), one apterous viviparae of *Wahlgreniella nervata* (Gillette), and two apterous viviparae of *E. nigromaculosum*. The latter two specimens were those described as *B. hottesi*. The caudas of these two specimens are badly deformed so that they appear constricted in several places, or twisted, as in *Bipersona*.

Bipersona Hottes 1926

Type species: *Aphis torticauda* Gillette 1907: 389–391. By original designation.

Diagnosis.—Large aphids (body length (bl) 2–3+ mm), normally dark red to brownish grey in life, with nymphs pink, orange, or red. Adults sometimes with paler or orange head and thorax and darker reddish to brown behind. Antennae shorter than body, dark brown to black, with numerous sensoria on antennal segment (a.s.) III and variable numbers on a.s. IV in apterous and alate

viviparae, with a few sensoria sometimes present on a.s. V of alate viviparae. Siphunculi dark brown to black with apical portion with fine polygonal reticulation, the remainder roughly imbricate. Cauda elongate, tapering with 4–8 lateral and subapical setae, and with about 3 asymmetrical constrictions in vivipara, making it appear twisted or convoluted in dorsal aspect (Figs. 1F, 3E). Cauda of ovipara and male shorter and less contorted. Anal plate with a conical posteriorly directed projection (Figs. 1C, 3D). Genital plate with numerous setae in addition to the normal two primary and row of posterior setae (Fig. 1D).

Notes.—This genus was described by Hottes in 1926 for *Aphis torticauda* Gillette. Hottes only mentioned *Aphis torticauda*, despite the fact that other species now referred to this genus had been described: *Aphis ochrocentri* Cockerell and *Aphis cnici* Williams. It is possible that Hottes was unaware of these other names. Hottes pointed out that the genus can be recognized easily by the peculiar structure of the cauda and anal plate, but we note that *Artemisaphis* Knowlton and Roberts has a similar anal plate. *Artemisaphis* normally has setae on the siphunculi, another unusual character. We have noticed setae on the siphunculi of a few *Bipersona* specimens, suggesting another link between *Artemisaphis* and *Bipersona*. *Artemisaphis* has at times been placed as a subgenus of *Obtusicauda* Soliman, most recently restored to genus rank by Robinson and Halbert (1989) because of its unique cauda and anal plate and the fact that it is tended by ants, while species of *Obtusicauda* are rarely ant attended. In short, *Bipersona* is likely a close relative of *Artemisaphis*, and possibly a slightly more distant relative of *Obtusicauda*.

With the exception of some host records from *Hypericum* (see Discussion), *Bipersona* aphids feed only on various thistles and like other species of thistle-feeding aphids [e.g., *Uroleucon longirostre* (Gillette and Palmer) and *Brachcaudus cardui* (L.)], *Bipersona* has a long, thin ultimate rostral segment. *Bipersona* is unusual among the Macrosiphini for its long cornicles and ant-tended association. Most species of aphids with ant attendance have short cornicles and caudas.

Bipersona ochrocentri (Cockerell 1903)
(Fig. 1)

Aphis ochrocentri Cockerell 1903: 248;
Bipersona ochrocentri: Palmer 1952: 247; Eastop and Hille Ris Lambers 1976: 106; Remaudière and Remaudière 1997: 77.

Type material.—Since Cockerell's (1903) type material is evidently lost, we have designated a neotype for clarification. From material collected approximately 25 miles from Cockerell's (1903) type locality, we have selected an aptera (far left position) as the neotype and have placed a label on the front of the slide with a map of the position of the specimen: left label states "*Bipersona torticauda* Gill., on thistle, Las Vegas, N. Mex., July 25, 1963, Horton & Nielsen, 63-17506, GN-105-63"; right label states "NEOTYPE *Bipersona ochrocentri* (Cockerell) det. G. L. Miller & A. S. Jensen 2005" (USNM). The right label also includes a map for clarification. See also Specimens Studied.

Field features.—Cockerell (1903) noted the apterae with "head, thorax and most of under parts pale pink; abdomen brownish plumbeous, delicately pruinose, more or less shining on disc; two segments anterior to cauda pale green," cauda black, "femora with basal half yellowish-white, apical half black; tibiae and tarsi, antennae and (slender) nectaries black." Alatae were of similar coloration but darker (Cockerell 1903). Ap-

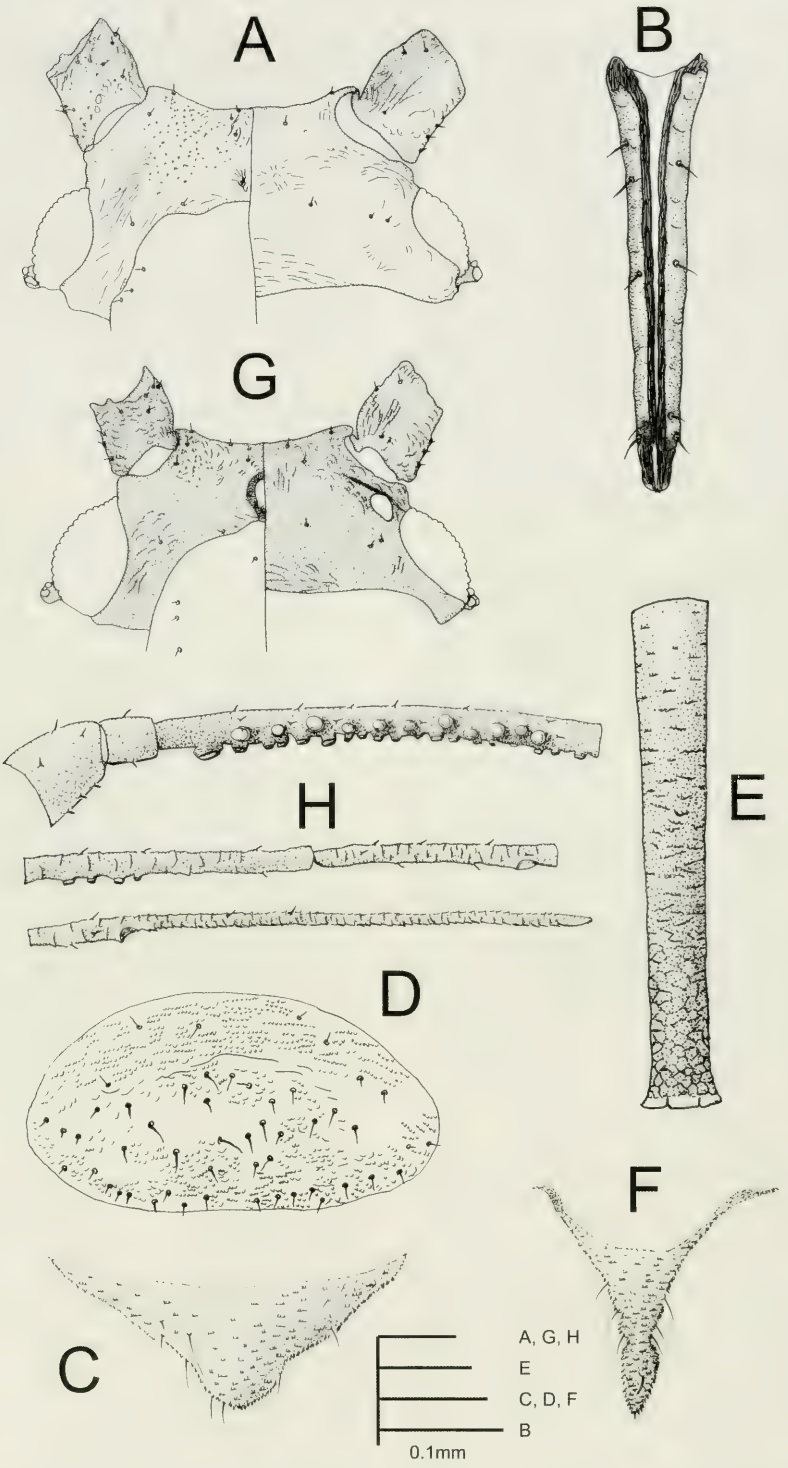


Fig. 1. *Bipersona ochrocentri*. A, Right side, aptera dorsum of head and antennal segment I; left side, aptera venter of head and antennal segment I. B, Utimate rostral segment. C, Anal plate with posterior projection. D, Genital plate of aptera. E, Cornicle of aptera. F, Cauda of aptera. G, Right side, alata dorsum of head and antennal segment I; left side, alata venter of head and antennal segment I. H, Alata antennal segments I–VI.

terous and alate specimens collected by one of us (ASJ) were dark red.

Biology.—Cockerell (1903) supplied no notes on biology of this species other than its association with a host plant (*Cirsium ochrocentrum* A. Gray). The only other information that applies to *B. ochrocentri* is from our own observations in western Arizona where these aphids were collected on *Cirsium* sp. in a very arid habitat and were ant tended. *Bipersona ochrocentri* are able to move quickly (not unlike many *Macrosiphoniella* species) as compared with other aphids.

Recognition characters.—*Aptera:* Body length 2.50–3.48; width through eyes, 0.61–0.67 Head (Fig. 1A) sclerotized, smooth dorsally and with some spicules ventrally; dorsal head setae stout, not much longer than diameter of their corresponding basal sockets, tips blunt. Antenna shorter than body, setae less than half width of segment; segment III 0.49–0.67 long with 9–30 secondary sensoria; IV 0.30–0.43 long without sensoria; V 0.25–0.38 without secondary sensoria; base of VI 0.11–0.15 long; terminal process, 0.46–0.55 long. Rostrum extending past metacoxae; ultimate segment (Fig. 1B) 0.30–0.41 long, nearly 4.5 times as long as wide at base, with 7–13 accessory setae. Pronotum and occasionally mesonotum with marginal tubercles. Hind tibia 1.26–1.74 long; hind tarsus II 0.13–0.19 long. Abdomen dorsally with faint fine reticulation and small intersegmental sclerites that appear as clusters of cells, dorsal setae stout, without basal sclerite, segment VIII with dorsal tergite that extends from lateral margins with 4–6 setae; ventrally spiculose; anal plate (Fig. 1C) with posterior projection and numerous setae, genital plate (Fig. 1D) with numerous setae; abdominal marginal tubercles usually present on segment II–V. Cornicle (Fig. 1E) 0.51–0.68 long, scabrous, tapering slightly with 10–12 rows of reticulations and small flange apically. Cauda (Fig. 1F) 0.14–0.20 long, elongate, contorted with 2–3 pairs of lateral setae and a subapical seta.

Alata (Fig. 1G): Similar to aptera except: body length 2.27–3.25; width through eyes 0.56–0.61. Antennal (Fig. 1H) segment III 0.50–0.61 long, with 26–41 secondary sensoria; IV 0.30–0.40 long, with 1–10 secondary sensoria; V 0.24–0.35 long, without secondary sensoria; base of VI 0.10–0.14 long; terminal process 0.48–0.65 long. Ultimate rostral segment 0.33–0.40 long, with 7–10 accessory setae. Hind tibia 1.30–1.51 long; hind tarsus II 0.15–0.18 long. Cornicle 0.35–0.56 long. Cauda 0.10–0.18 long.

Notes.—This species was first described by Cockerell in 1903, apparently based on few specimens. His descriptions lacked almost all details considered necessary today. Extensive search for the types of this species was unsuccessful, forcing us to designate a neotype. We were faced with two distinctive species and had to use Cockerell's vague description to decide which of the two species was in fact *B. ochrocentri*. The one decisive character provided by Cockerell was the numbers and shape of the sensoria on the antennae of the alate vivipara of *B. ochrocentri*. Our specimens from New Mexico and Arizona closely matched this part of the description, while the specimens of *B. torticauda* have differently shaped sensoria and more of them. In addition, Cockerell described *B. ochrocentri* from the same region of New Mexico from which some of our specimens were collected. One possibility was that both Cockerell and Gillette had described the same species. This seemed unlikely based on the antennal characters just mentioned, but also because of the following statement made by Palmer (1952) in reference to the distinction between *B. ochrocentri* and *B. torticauda:* "This species seems very close to *Aphis ochrocentri*, judging from the original description, but Gillette after

examining type specimens considered the species as distinct but recorded no detailed comparison." Palmer's statement about Gillette's examination of types implies that Gillette was able to see types of *B. ochrocentri*. Since Palmer (1952) noted that the types of *B. ochrocentri* were "unavailable" and we were not able to locate them either, Gillette's opinion is the only other evidence we have that the two descriptions refer to different species.

Palmer also refers to a note in Cockerell (1893), which she listed under collections of *B. ochrocentri*. This collection was listed by Cockerell (1893) as an unidentified *Aphis* species from Colorado. It is likely that this collection was in fact *B. torticauda*, considering it was collected in Colorado, not New Mexico or Arizona.

Specimens examined.—UNITED STATES OF AMERICA: ARIZONA, Yavapai Co., I-40, exit 109, VII-7-2004, on *Cirsium* sp., A. Jensen coll. (5 ap., 3 al., 1 imm. on 3 sl.) USNM; NEW MEXICO, 1.5 mi. N. Elida, Presidio, VIII-15-1952, on Canada thistle [*Cirsium arvense*], J. H. Russell coll. (6 ap., 2 al., on 3 sl.) USNM; Las Vegas, VII-25-1963, on thistle, Horton & Nielsen coll. (2 ap., 1 imm., separate label on right side with "NEOTYPE" and map) USNM; Roswell, VII-17-[no year given], on thistle, [no collector given] (2 al., 1 imm.[one specimen on slide is not conspecific]) USNM.

Bipersona torticauda (Gillette, 1907)
(Figs. 2–3)

Aphis torticauda Gillette 1907: 389.
Aphis cnici Williams 1911: 40 (preoccupied); Davis 1911: 12.
Aphis williamsi Soliman 1927: 97 (replacement name).
Bipersona torticauda: Hottes 1926: 115; Gillette and Palmer 1934: 143; Palmer 1952: 247; Eastop and Hille Ris Lambers 1976: 106; Remaudière and Remaudière 1997: 77.

Systematic notes.—Williams (1911) described *Aphis cnici* from *Cnicus* sp. in Nebraska. Soliman (1927) noted that the name was preoccupied by *Aphis cnici* Schrank (1801), and established the name *Aphis williamsi* for the aphid described by Williams. We have examined the types of *Aphis torticauda* and *Aphis cnici* Williams (= *Aphis williamsi* Soliman), and concluded that they are conspecific in agreement with Hottes (1930). *Bipersona torticauda*, as defined here, is a variable species living in a wide range of habitats, on different host plants, and exhibiting color variation. Gillette (1907) also noted differences in color but believed it was only a variation. We considered the possibility that more than one species may be involved, but lacking useful characters for morphological separation, we decided to retain all *B. torticauda*-like specimens under one name. In addition, with our work, *B. torticauda* is restored as the type species versus that of *B. ochrocentri* (i.e., Eastop and Hille Ris Lambers 1976, Remaudière and Remaudière 1997).

Type material.—Gillette (1907) did not designate types within his treatment of *Aphis torticauda* (= *B. torticauda*). However, within his species description, he did record collection dates and localities for the various life cycle stages on which he based his description (June 14, July 22, October 26, and October 27, 1907). From the original collection series we were able identify specimens on four microscope slides that probably represent the syntypes on which he based his descriptions. However, several inconsistencies exist with collection dates listed on these slide labels versus those published by Gillette in 1907. They are as follows: (1) three of the slides are labeled as July 23, 1907 and not July 22, 1907, and (2) one slide is labeled as September

27, 1907 and not October 27, 1907 as published in Gillette (1907). These disparities may represent a printer's typographic or transcription error. This theory may be borne out in the correspondence between Gillette and Pergande dated November 29, 1907 (National Aphid Collection card file record 124013) where Pergande recorded receipt of a single slide from Gillette that contained specimens he collected on July 23 and October 26, 1907. Since the Gillette (1907) description of the apterous male is from October 26, we believe this slide represents this material. Explaining the discrepancy of the slide dated September 27, 1907 is more hypothetical. Gillette's description of apterous oviparae from October 27, 1907 stated that "several specimens were taken in copula." Examination of the September 27, 1907 specimens revealed both apterous oviparae and apterous males. Again, these disparities may represent a printer's typographic or transcription error. From the above material and for nomenclatural stability, we designate a lectotype specimen. Except for one specimen which is not congeneric (and noted of the slide label), all other specimens are paralectoypes. From the 18 syntypes we have selected an aptera (at the 9 o'clock position) as the lectotype and have placed a label on the back of the slide with a map of the position of the specimen. Information for the three microscope slides that contain the lectotype and paralectotypes are as follows: (slide 1.) front left label (with map and arrows) states "(*Aphis*) *Bipersona torticauda*, n. sp. Type, Apt. viv., paratype, ♂(?), C. P. Gillette"; top label "U.S. Nat. Mus. Cat No 42817"; right label "on *Carduus* 7-23-07 Ft. Collins, Colo., Coll. C. P. Gillette, Colo. Agr. Exp. Sta. Ac. 7-23-07"; back left label "*Bipersona torticauda* (Gillette) conf. det. G. L. Miller & A. S. Jensen 2005"; back right label "LECTOTYPE & PARALECTOTYPES. (with map and arrows) det. G. L. Miller & A. S. Jensen 2005" (USNM); (slide 2.) front left label "124014 PARALECTOTYPES det. G. L. Miller & A. S. Jensen 2005; front right label "*Aphis* ♂♂♀♀ *torticauda* n.sp. Ft. C. Colo., from *Carduus* sp., Collected by C.P.G., Co-Types"; back left label "*Bipersona torticauda* (Gillette) conf. det. G. L. Miller & A. S. Jensen 2005, CO: Fort Collins, on *Carduus* sp., 23 July & 26 Oct. 1907, C. P. Gillette coll.; back right label "Collection information from aphid card file. Evidently, Gillette made the slide from multiple collections. GLM 24 May 2005" (USNM, as per National Aphid Collection card file record 124013 dated 7 October 1907); and (slide 3), front left label "*B. torticauda* (Gill.), Fort Collins, 9-27-07, Colo., ♂♀Type, C.P.G."; bottom center label "Metatype"; front right label "PARALECTOTYPES (with map and arrows) det. G. L. Miller & A. S. Jensen 2005; back right label "*Bipersona torticauda* (Gillette) conf. det. G. L. Miller & A. S. Jensen 2005 (CSUC).

Three slides containing 18 specimens of *B. torticauda* were sent to the USNM in 1930 (USNM Cat. No. 42817) that were variously labeled with type, paratype, metatype, and neotype. While we consider two of the slides as part of the original type series as detailed above, the third slide from Poudre Canon, Colorado on V-30-1929 should not be considered part of the type series. We have also studied 18 syntypes on three slides labeled "COTYPE" of *Aphis cnici* Williams (USNM) from NEBRASKA, War Bonnet Cr., VI-23-1890, on *Cnicus* sp., T. A. Williams coll., (8 al., 8 imm. on 3 sl.) USNM.

Field features (Fig. 2).—Aptera: color variable with "entire dorsum, including head, unicolorous-red; eyes, distal ends of femora, tibiae, and all of tarsi, cornicles and antennae black or blackish" (Gillette 1907) or "brick-red to red-

Fig. 2. Colony of *Bipersona torticauda* and tending ants on *Cirsium flodmanii*. Photograph courtesy of T. Rand.

ochre" with appendages and cornicles black and anal plate and cauda "reddish to dusky distally" (Palmer 1952). However, one of us (ASJ) collected specimens which ranged from black with orange thorax to dark red with an orange head. Alata: coloration similar to apterae (Gillette 1907) or brick red to ochre red with brownish thoracic lobes and dusky to black appendages (Palmer 1952). Ovipara: similar to apterae except anal plates as conspicuously black (Gillette 1907). Apterous male: "sordid yellowish-brown or greenish-rufous with pronounced tinge of rufous upon head and thorax" and "antennae, eyes, distal halves of femora and tibiae, tarsi, cornicles, beak and anal plates black or blackish" (Gillette 1907).

Biology.—Gillette (1907) provided good notes on the biology of this species: "No eggs were seen until after the appearance of the wingless fall brood of males during the latter part of September and October. This louse is always well attended by ants, and I have been unable to find eggs upon the food-plants in the field, but when the lice are brought into the laboratory and kept for a few days upon thistle, eggs are laid in considerable numbers. They are light green in colour at first, but become polished black in a few days. I cannot help wondering if the ants carry away the eggs." The second author has collected this species several times, and found it tended by ants in every case (Fig. 2). Similarly to *B. ochrocentri*, these aphids are fast-moving, tending to withdraw their stylets and run down the plant stem at the slightest disturbance.

In spring, the alate viviparae that have settled on bolting thistle plants become hugely gravid with nymphs, explaining Williams' (1911) statement that, "This is the largest aphis that I have ever seen." Gillette's (1907) remarks about alate males in July were in error since Palmer (1952) noted the specimens were actually shriveled viviparae. We have confirmed her findings.

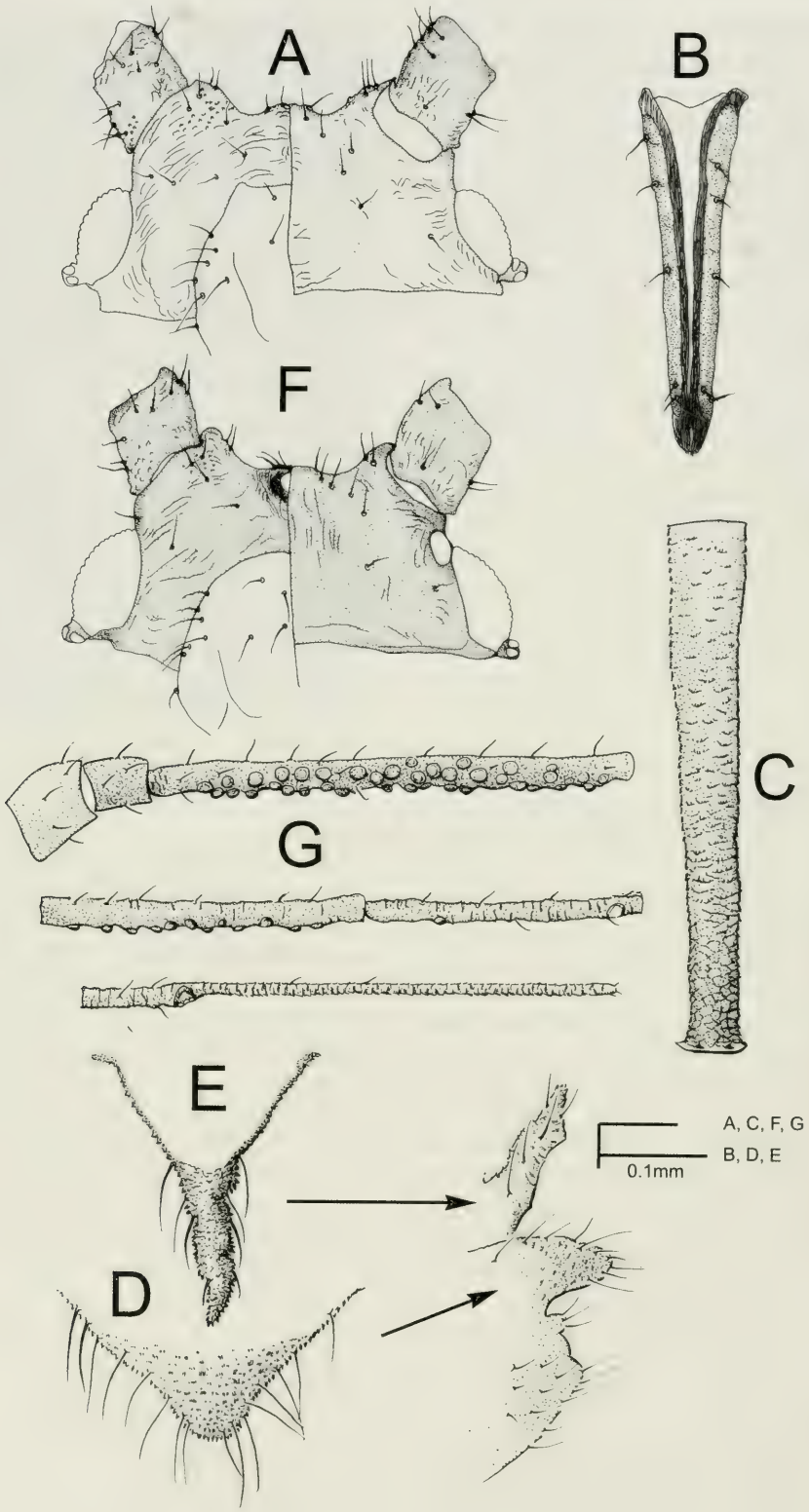
Recognition characters.—*Aptera:* Body length 2.45–3.73; width through eyes, 0.56–0.72. Head (Fig. 3A) sclerotized, smooth; dorsal head setae long, approximately 5–7 times longer than diameter of their corresponding basal sockets; tips of dorsal head setae pointed. Antenna shorter than body, setae more than half width of segment; segment III 0.53–0.90 long with 21–42 secondary sensoria; IV 0.34–0.70 long with 0–9 secondary sensoria; V 0.32–0.45 long with 0–2 (usually absent) sensoria; base of VI 0.11–0.17 long; terminal process, 0.44–0.65 long. Rostrum extending past metacoxae; ultimate segment (Fig. 3B) 0.26–0.38 long, nearly 4 times as long as wide at base, with 11–19 accessory setae. Pronotum and occasionally mesonotum and metanotum with marginal tubercles. Hind tibia 1.40–2.20 long; hind tarsus II 0.16–0.20

long. Abdomen dorsally with faint fine reticulation and small intersegmental sclerites that appear as clusters of cells, dorsal setae often with faint associated basal sclerite, segment VIII with dorsal tergite that extends from lateral margins with 6–8 setae; ventrally spiculose; anal plate (Fig. 3D) with posterior projection and numerous setae; genital plate with numerous setae; abdominal marginal tubercles usually present on segment I–V. Cornicle (Fig. 3C) 0.45–0.84 long, scabrous, tapering slightly with 10–12 rows of reticulations and small flange apically. Cauda (Fig. 3E) 0.11–0.23 long, elongate, contorted with 3–4 pairs of lateral setae and a subapical seta.

Alata (Fig. 3F): Similar to apterous female except: body length 2.13–3.46; width through eyes 0.52–0.78. Antennal (Fig. 3G) segment III 0.52–0.92 long, with 36–63 secondary sensoria; IV 0.35–0.75 long, with 10–18 secondary sensoria; V 0.33–0.54 long, with 0–5 secondary sensoria; base of VI 0.12–0.19 long; terminal process 0.50–0.79 long. Ultimate rostral segment 0.26–0.40 long, with 11–17 accessory setae. Hind tibia 1.27–2.32 long; hind tarsus II 0.15–0.22 long. Cornicle 0.40–0.74 long. Cauda 0.09–0.20 long.

Notes.—*Bipersona torticauda* can be distinguished from *B. ochrocentri* primarily by its longer setae on the head, antennae and elsewhere, as depicted in Figs. 3A, F, and G. The presence of lateral tubercles on abdominal tergite I in *B. torticauda* also may be a diagnostic character. As noted in the descriptions, *B. torticauda* tends to have more sensoria on antennal segments III and IV, but there is substantial overlap in the ranges. There is also a subtle difference in shape of the secondary sensoria between the species, with the sensoria of *B. torticauda* being less protuberant than in *B. ochrocentri*.

Specimens examined.—CANADA: BRITISH COLUMBIA, Westbank, on *Cirsium* sp., VI-9-54 [1954], G. L. Ayre coll., (1 al.) CNCI; on *Hypericum* sp., VIII-9-54[1954], Ayre-Wilson coll., (1 ap.) CNCI; Canal Flats, on thistle, VII-12-1955, [no collector given], (1 ap.,1 al. on 2 sl.) CNCI; Oliver, Meyers Flats, on thistle, VI-29-1959, L.A.K. [Leonard Kelton] coll., (1 ap.) CNCI; Keremeos, on *Cirsium* sp., VII-17-1965, W. R. Richards coll., (3 ap., 2 al. on 5 sl.) CNCI; 2 mi. S. Spencer Bridge, [no host given], VII-4-1966, F. Andrews coll., (1 ap.) EMEC; Grand Forks, IX-05-1984, on *Hypericum perforatum*, [no collector given], (2 ap. on 2 sl.) CNCI; SASKATCHEWAN, 5 mi. W. of Furness, VIII-6-40[1940], on scotch thistle [probably *Cirsium* sp., E. Maw, personal communication], A. R. Brooks coll., (1 ap., 1 al. on 2 sl.) CNCI; UNITED STATES OF AMERICA: COLORADO, Lake Co., Hwy 24 N. of Buena Vista, VII-4-2004, on *Cirsium undulatum*, A. S. Jensen coll., (2 ap., 2 al., 2 imm. on 3 sl.) ASJC; Weld Co., Central Plains Exp. Range, 8 km N. Nann, VIII-17, 25-1976, on *Cirsium megacephalum* [*Cirsium undulatum*], J. A. Scott coll., (2 ap.) USNM; Ft. Collins, VI-30-98 [1898], on *Cnicus* sp., C. P. G. [C. P. Gillette] coll., (14 al. on 2 sl., slides have "Metatype" labels) CSUC; X-3-06 [1906], no host listed, L.C.B. [L. C. Bragg] coll., (1 ov., 1 ap. ♂, 2 indeterminable) CSUC; VII-23-07 [1907], on *Carduus* sp., C. P. Gillette coll., (2 ap., 3 al., slide label has "Type" and "paratype" written, separate label with "U.S. Nat. Mus. Cat. No. 42817, separate label on back with "LECTOTYPE" and "PARALECTOTYPES" and map) USNM; on *Carduus* sp., C. P. Gillette coll., (1 ov., 1 ap., 2 al., 1 ap. ♂, slide has "Types" written on label, separate label on front "PARALECTOTYPES") USNM; VII-29 & X-3-1907, on *Carduus* sp.?, C. P. Gillette coll., (13 ov., 2 ap., 2 al., 3 imm., 1 indeterminable on 2 sl., both slides have "Types" labeled on them) USNM; IX-27-07 [1907], no host data, C. P. G. [C. P. Gillette] coll.,


A
B
F
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(3 ov., 4 ♂, slide has "Types" written on label and separate "Metatype" label, one imm. specimen on slide is not conspecific, separate label on front with "PARALECTOTYPES" and map) CSUC; X-3-07 [1907], on *Carduus* sp., C. P. G. [C. P. Gillette] coll., (5 ov., 1 ap. ♂, slide has "Types" and "Paratype" labels) CSUC; X-18-07 [1907], on *Carduus* sp., C. P. Gillette coll., (3 ov., 2 ap. _, front slide label has "Types" and "paratypes" written, separate label with "U.S. Nat. Mus. Cat. No. 42817") USNM; VI-8-1908, on "*Cardus*"[*Carduus* sp.?] L.C.B. [L. C. Bragg] coll., (1 ap., 13 al. on 4 sl., one slide from ESUC labeled "Metatype") CSUC, ESUC, USNM; VI-12-08 [1908], no host listed, L.C.B. [L. C. Bragg] and C. P. G. [C. P. Gillette] colls., (4 al., slide has "Metatype" label) CSUC; VII-16-08 [1908], on *Carduus* sp., no collector listed, (1 ap., 3 al., slide has "Metatype" label) UMSP; V-13-09 [1909], on thistle, L.C.B. [L. C. Bragg] coll., (6 fund., 2 imm. on 2 sl., slides have "Types" and "Metatype" label) CSUC; VI-12-09 [1909], on thistle, C. P. G. [C. P. Gillette] coll., (4 al., 2 ap., slide has "Metatype" label) CSUC; V-22-09 [1909], on thistle, L.C.B. [L. C. Bragg] coll., (5 fund. 2 imm.on 3 sl., one slide has "Metatype" label) CSUC; V-20-10 [1910], on thistle, L.C.B. [L. C. Bragg] coll., (1 al., 5 ap., slide has "Metatype" label) CSUC; V-26-11, on thistle, L.C.B. [L. C. Bragg] coll., (3 ap., 2 al., 1 imm.on 10 sl.) USNM; VII-1-11 [1911], on thistle, L.C.B. [L. C. Bragg] coll., (4 ap., 20 al.) CNCI, UMSP; VIII-10-1912, on *Carduus* sp., L. C. Bragg coll., (4 ap.) EMEC; VIII-22-12 [1912], on *Cnicus* sp., L.C.B. [L. C. Bragg] coll., (14 ap., 1 al., 4 imm. on 2 sl., one slide has "Metatype" label) CSUC; IX-22-15 [1915], on *Cnicus* sp., Bragg coll., (3 ap., 1 al., 10 ov., 7 imm. on 2 sl., CSUC slide has "Metatype" label) CSUC, USNM; VIII-27-20[1920], on thistle, C. P. G. [C. P. Gillette] coll., (5 ap., 1 imm.) CNCI; VIII-16-21 [1921], no other host or collector data, (10 ap., 2 imm., slide has "Metatype" label) CSUC; VIII-1-22 [1922], on *Carduus* sp., C. P. G. [C. P. Gillette] coll., (7 ap., slide has "Metatype" label) CSUC; VII-29-25 [1925], on *Cirsium filipendulum* [*Cirsium engelmannii*], C. P. G. [C. P. Gillette] coll., (3 al., 4 ap., slide has "Metatype" label) CSUC; Horsetooth Gulch, VII-08-09 [1909], on thistle, O. G. B. & M. A. P. [M. A. Palmer] colls., (4 al., 6 ap.) UMSP; on *Carduus* sp., VI-16-18 [1918], collector not listed, (3 al., 5 ap., 10 imm. on 3 slides, slides have "Topotype" marked on labels) UMSP; VI-16-18 [1918], no other data listed, possibly part of series from previous slide, (5 al.) CSUC; Longmont, VII-1-12 [1912], on thistle, no other data, (1 al., 5 ap., 4 imm. on 2 sl.) CSUC; Loveland, VI-17-15 [1915], on thistle, L.C. B. coll.[L. C. Bragg], (5 ap., 20 al., 4 imm. on 4 sl., CSUC slides have "Metatype" labels) CSUC, UMSP; Ingleside, IX-9-1922, on *Carduus* sp., F. C. H. coll. [F. C. Hottes], (4 ov.) USNM; Log Cabin, VII-30-26 [1926], on *Circium* [*Cirsium*] sp., C. P. G. [C. P. Gillette] coll., (3 ap., slide has "Metatype" label) CSUC; Poudre Canyon, V-30-29 [1929], on *Carduus* sp., M. A. P. [M. A. Palmer] coll., (12 al., 3 ap., on 2 sl., CSUC slide has "Metatype" label, USNM slide has

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Fig. 3. *Bipersona torticauda*. A, Right side, aptera dorsum of head and antennal segment I; left side, aptera venter of head and antennal segment I. B, Utimate rostral segment. C, Cornicle of aptera. D, Anal plate with posterior projection and corresponding lateral view. E, Cauda of aptera and corresponding lateral view. F, Right side, alata dorsum of head and antennal segment I; left side, alata venter of head and antennal segment. G, Alata antennal segments I–VI.

label with "Neotype" and "metatypes" and "U.S. Nat. Mus. Cat. No. 42817") CSUC, USNM; Pingrae Pk., VIII-19-29 [1929], on *Carduus* sp., C. P. G. [C. P. Gillette] coll., (4 ap., slide has "Metatype" label) CSUC; Hereford, VII-4-36 [1936], on thistle, M.. A. P. [M. A. Palmer] coll., (2 al., 5 imm.) CSUC; Glode Park, VI-16-1948, on thistle, [no collector listed], (3 al.) USNM, Roosevelt Forrest Canyon, VIII-6-60 [1960], on thistle, S. S. Thatcher coll., (3 ap., 1 imm.) EMUS; Cameron Pass, VIII-10-1964, on bull thistle, G. F. Knowlton coll., (1 al., 3 ap., 1 imm.) EMUS; Gould, VIII-11-64 [1964], on thistle, G. F. Knowlton coll., (2 ap., 3 imm.) EMUS; VI-2-68 [1968], on thistle, Smith-Nelsons coll., (2 al., 8 ap. on 3 sl.) EMUS; Estes Park, VII-26-1973, on *Cirsium undulatum*, H. G. Walker coll., (10 ap. on 5 sl.) USNM; VIII-11-1977, on *Cirsium coloradense* [*Cirsium tioganum*], (3 imm.) USNM; IDAHO, Clark Co., IX-4-1977, on *Cirsium* [other host listed but illegible], W. H. Clark coll., (12 ap., 6 imm. on 6 sl.) INHS; Holbrook-Summit, VI-18-1969, on bull thistle, G. F. Knowlton coll., (1 ap.) USNM; 5 mi. N.W. Holbrook, VII-14-1971, on Utah thistle [*Cirsium neomexicanum*?], G. F. Knowlton coll., (3 ap.) EMUS; Twin Springs, VII-14-1971, on Utah thistle [*Cirsium neomexicanum*?], G. F. Knowlton coll., (7 ap. on 4 sl.) USNM; Cub River Canyon, VI-29-1979, on *Cirsium*, G. F. Knowlton coll., (9 ap., 4 imm. on 3 sl.) EMUS; IOWA, Lakeside Lab, VIII-11-1925, on thistle, S. Therwait coll., (2 ap., 1 imm.) USNM; on Canadian thistle leaf [*Cirsium arvense*], A. Kaatz coll., (2 ap., 1 imm.) USNM; MINNESOTA, Marshall, VII-1926, on thistle, F. C. H. [F. C. Hottes], (1 ap., 1 al., 2 imm. on 3 sl.) UMSP; MONTANA, Edgar, VI-26-14 [1914], on thistle, A. C. M. coll., (2 ap., 3 al., 2 imm. on 2 sl., one slide has "Metatype" label) CSUC; Madison Co., Hidden Lake Beach, VIII-1990, on *Cirsium seariosum* [?], R. Ryti coll., (2 ov. on 2 sl.) INHS; NEBRASKA, Brown Co., Niobrara Valley Preserve, V-26-2003, on *Cirsium undulatum*, T. A. Rand coll., (11 ap., 24 al., 3 imm.on 10 sl.) CNCI, FSCA, USNM; Buffalo Co., 2 mile NNE of Odessa, V-23-2003,VI-15-2003, VII-23-2003, *Cirsium flodmanii*, T. A. Rand coll., (40 ap., 18 al., 11 imm.on 29 sl.) USNM; Sioux Co., VI-19-1969, on thistle, C. K. Smith & C. F. Smith colls., (2 al., 2 ap.) EMUS; War Bonnet Cr., VI-23-90 [1890], on *Cnicus* sp., T. A. Williams coll., (8 al., 8 imm. on 3 sl., slides labeled "COTYPE" for *Aphis cnici* Williams) USNM; VI-24-90 [1890], on small legume, (1al., other specimens are not conspecific) USNM; Ord, VIII-3-1971, on musk thistle [*Carduus nutans*], J.M. Schade coll., (6 ap., 5 imm. on 4 sl.) USNM; SOUTH DAKOTA, Brown Co., on *Cnicus* sp., VII-25-1916, T. A. Williams coll., (18 ap., 1al., 11 imm.on 4 sl.) USNM; UTAH, Tooele, VII-5-14 [1914], on thistle, C. P. G. [C. P. Gillette] coll., (1 ap., slide has "Metatype" label) CSUC; VI-15-15 [1915], on thistle, C. P. G. [C. P. Gillette] coll., (11 al., 7 ap. on 2 sl.) CSUC, EMUS; Salt Lake City, VI-15-1937, on *Cirsium* ?, G. F. Knowlton coll., (1 al.) EMUS; Trenton, VI-11-1938, on bull thistle, G. F. Knowlton coll., (1 al.) EMUS; Ft. Green, V-26-1939, on bull thistle, G. F. Knowlton coll., (10 al., 1 ap., 2 imm on 4 sl.) EMUS, USNM; W. Ephrain, VI-8-1942, on thistle, G. F. Knowlton coll., (3 al., 2 ap.) EMUS; Provo, VII-3-1946, on bull thistle, G. F. Knowlton coll., (14 ap., 1 imm on 3 sl.) EMUS; Yuba Dam, VII-3-1946, on bull thistle, G. F. Knowlton coll., (1 al., 4 ap.) EMUS; Spanish Fork, VII-10-1950, G. F. Knowlton coll., (2 al., 1 ap., 3 imm.) FWQC; Deseret, VI-7-1960, on thistle, G.F.K.[G. F. Knowlton] coll., (2 al., 2 ap., 1 imm. on 2 sl.) EMUS; Filmore, VI-7-1960, on thistle, G. F. Knowlton coll., (2 al., 2 ap., 2 imm.) USNM; Holden, VI-7-1960, on

thistle, G. F. Knowlton coll., (3 al., 1 ap., 1 imm.) EMUS; Eureka, VII-19-1962, on large thistle, G. F. Knowlton coll., (4 ap.) EMUS; Vernon, VII-19-62 [1962], on thistle, G. F. Knowlton coll., (4 ap., 4 imm.) EMUS; Oak City, VI-6-65 [1965], on thistle, G. F. Knowlton coll., (4 ap.) EMUS; Duchesne, VI-17-65 [1965], on large thistle (cow), G. F. Knowlton coll., (1 al., 5 imm. on 2 sl.) EMUS; Daniels Canyon, VI-17-1965, on brown thistle, G. F. Knowlton coll., (1 al.) EMUS; Arcadia, VI-18-1965, on cow thistle, G. F. Knowlton coll., (4 ap., 3 imm. on 5 sl.) EMUS, USNM; Alton, VII-21-1965, on thistle, G. F. Knowlton coll., (1 al.) USNM; Mt. Sterling, VIII-21-1965, on thistle, G. F. Knowlton coll., (3 ap., 1 imm. on 2 sl.) EMUS, USNM; Alpine, VI-21-1966, on thistle, G. F. Knowlton coll., (3 ap., 3 imm. on 5 sl.) EMUS, USNM; Beaver, VI-7-1968, on thistle, G. F. Knowlton coll., (10 ap., 3 imm. on 6 sl.) USNM; Mona, VII-18-68 [1968], on bull thistle, G. F. Knowlton coll., (3 ap.) EMUS; Hansel Mts., VII-2-1970, on bull thistle, G. F. Knowlton coll., (8 al., 3 ap. on 5 sl.) EMUS, USNM; Blacksmith Fork Canyon, VI-28-1971, on thistle, G. F. Knowlton coll., (4 al., 2 ap. on 2 sl.) EMUS, VI-28-1979, on *Cirsium* sp., G. F. Knowlton coll., (6 ap. on 3 sl.) EMUS; Twin Springs, VI-30-1971, on Utah thistle [*Cirsium neomexicanum*?], G. F. Knowlton coll., (2 al., 2 ap.) EMUS; WASHINGTON, Adams Co., Benge Winona Rd., VI-28-2004, on *Cirsium* sp., (7 ap., 3 al., 1 imm.on 10 sl.) ASJC; Whitman Co., Winona, VI-24-1981, on *Cirsium undulatum*, (7 al., 15 ap., 5 imm. on 12 sl.) INHS; Vantage, Columbia River, VI-27-1960, on *Juniperus* sp. [probably an incidental host], E. I. Schlinger coll, (1 al.) EMEC; WYOMING, Albany Co., Laramie, VII-27-1919, no host listed, L.C.B. [L. C. Bragg] coll., (1 al., 5 ap., imm., slide with "Metatype" label) ESUC; VII-8-1982, on platte thistle [*Cirsium canencens*?], E. W. Spackman coll., (6 ap. on 3 sl.) USNM; Converse Co., Glendo, VIII-8-2004, on *Cirsium* sp., A. S. Jensen coll., (6 ap. on 3 sl.) ASJC; Brooklyn Lake above U. of Wyo. Camp., VIII-17-32 [1932], on thistle heads, M. A. P. [M. A. Palmer] coll., (27 ap., 1 al., 15 imm.on 3 sl.) CSUC; One Tree, VII-27-1949, on *Cardinus* [possibly host error], G. F. Knowlton coll., (8 ap., 1 al., 1 imm. on 2 sl.) EMUS, USNM.

Discussion

Many of the older host records for *Bipersona* refer to *Cnicus* spp. or *Carduus* sp. which reflects plant taxonomy at that particular time. As recognized today, there is only one species of *Cnicus* (*Cnicus benedictus* L.) in the continental U.S.A. (USDA, NRCS 2005). In addition, there are records of *Bipersona* from species of *Carduus* and from plants referred to as "bull thistle." As with *Cnicus*, we suspect that most records of *Bipersona* from *Carduus* are probably associated with *Cirsium* spp. as currently recognized. Although *Bipersona* feeds almost exclusively on *Cirsium* spp. it is interesting to note the collection of *B. torticauda* on *Hypericum* from Canada. E. Maw, CNCI, (personal communication) believes that the Canadian records on *Hypericum* sp. should not be dismissed as "incidental" since collection was made at two different dates, in the same general area, and with multiple specimens. We concur and had originally considered the idea that such different host associations may even represent a different aphid species. However, we were not able to detect any substantial differences from these specimens compared with those found on other hosts.

Since several species of *Cirsium* are invasive or represent noxious plants (e.g., *Cirsium arvense, Cirsium flodmanii*, and *Cirsium vulgare*) (USDA, NRCS 2005), we had some initial interest in the

association of *Bipersona* with these hosts. The plant association coupled with the fact that aphids constitute one of the largest groups of known plant-virus vectors (Chan et al. 1991) in addition to their mechanical feeding damage makes them a possible candidate as biological control agents. As reflected above, proper host plant associations and a virus specific to *Cirsium* would be integral in developing a control program. However, from our limited field observations, we note *Bipersona* populations are often neither abundant nor were there any visible signs of feeding damage or disease on the host. At sample sites in Brown Co. and Buffalo Co., Nebraska, *B. torticauda* populations could be large and ant-tended on individual plants but, occupied only about 10% of the thistles at a given site and no disease related damage was noted (T. Rand, personal communication). The distribution of *Bipersona* is apparently restricted to North America west of Iowa and Minnesota even though the distribution of the possible host is much broader.

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